

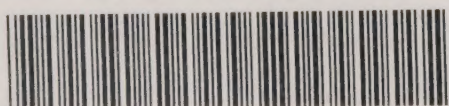
C. S. Killman

THE WALTER AND ELIZA HALL
INSTITUTE
OF RESEARCH IN
PATHOLOGY AND MEDICINE

THE DIRECTOR'S
TWENTY - FIFTH
ANNUAL REPORT
1943-44



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1944

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Historical Preface

The Walter and Eliza Hall Institute of Research in Pathology and Medicine was founded in 1916. The Trustees of the late Walter and Eliza Hall completed the Pathological Block of the present Royal Melbourne Hospital, and provided an annual payment of £2500 towards the upkeep of the Institute. In 1925 this was increased to £3100, and since 1930 has been £3200 annually. In addition, the Institute has received, since its inception, £500 per annum through the University from the Clinical Fund of the Melbourne Hospital, the Medical Staff of the hospital having agreed that this portion of its clinical fund should be used to provide for the direction of the routine pathological services and the teaching of students. Since 1925 a further sum of £250 per annum has been provided by the University from interest on the Appeal Fund (1924), together with an annual contribution from the Clinical Research Fund.

In 1926 the late Sir Aaron Danks, then President of the Melbourne Hospital, established an Endowment Fund to support a Biochemical Department. This fund has now reached the total of £10,151. The Edward Wilson Trustees maintained this new department by contributing £1500 per annum in 1926, 1927 and 1928, and £1000 in 1929. This Trust also, in 1926, contributed £3000 for the foundation of an Institute Library, and of this sum £2000 has been invested as endowment.

The Institute has been supported by annual contributions from the Felton Bequest Committee (since 1928), the Trustees of the late Anthony Mackie (since 1933), and the Trustees of the late T. J. Sumner since 1929. The Trustees of the late Alfred Edments have also helped us since 1937.

The Institute has received substantial support from the Department of Health of the Commonwealth Government; in the years 1927, 1928, 1929, 1930 and 1931 a total of £10,650 was received for special researches. In 1934 the Commonwealth Government entered into an agreement with the Rockefeller Foundation that each would contribute to the Institute the sum of £1000 per annum for the ensuing three years to support work on Virus diseases, particularly those affecting the central nervous system. In 1937 the Rockefeller Foundation and the Department of Health of the Commonwealth Government agreed to continue their support of this work for a further two years. Mr. E. Alex. Cato generously contributed £1000 per annum toward the maintenance of the programme of virus research for the years 1939 to 1943. The National Health and Medical Research Council have provided additional funds each year since it was established in 1937, and have assisted greatly in the development of the Institute.

In 1932, by the will of the late Mrs. L. E. W. Carty, of Brisbane Hill, Hamilton, the Elsie Marion Carty Fund was founded. Mrs. Carty willed to the Institute a portion of her estate and a residuary interest therein to establish this Fund. It was her wish that the income should be used primarily for the assistance of promising research workers.

From 1934 to 1937 Mr. A. M. Nicholas gave an annual sum of £250 towards the salary of the Assistant Director, and Mrs. Nicholas generously continued this contribution in 1938 and 1939.

In 1936 the Carnegie Corporation of New York paid the travelling expenses of Dr. W. Feldberg and his family to Australia, and

contributed in addition 4500 dollars, which, with £1100 collected by Mr. Reuben Hallenstein, made it possible to maintain this worker for two years.

It was finally decided in May, 1938, to rebuild the Royal Melbourne Hospital on the new site in Parkville. The Committee of Management subsequently accepted the responsibility for a new Institute building, the cost of which was estimated at £45,000. Towards this amount Mr. G. R. Nicholas and the family of the late Mr. A. M. Nicholas—Mrs. A. M. Nicholas, Mr. Maurice Nicholas, and Mrs. William Gluth—contributed £20,000. Mr. Russell Grimwade and the Broken Hill Proprietary Company Limited gave each £1000, and a few other gifts have brought the special fund for this purpose to a total of £22,075.

The occupation of the new Institute building was a gradual process; on 7th May, 1941, the Biochemical Department, and on 25th March, 1942, the Virus Department, moved into the new laboratories; the remainder of the Institute was occupied on 22nd September, 1942.

In 1942 the Gordon Clunes Mathison Research Scholarship was founded by a bequest of £6500 from the estate of his mother, Mrs. Mary Martin Mathison, and the sum of £539 from the estate of Mr. Joseph Smith was added to the Biochemical Endowment Fund.

The Institute is controlled by a Board consisting of representatives of the Walter and Eliza Hall Trust, of the University of Melbourne, and of the Committee of Management and Medical Staff of the Royal Melbourne Hospital. During the first Great War Professor Sir Harry Allen acted as Honorary Director. In 1919 Dr. S. W. Patterson was appointed first Director. In April, 1923, he resigned, and after a brief interval in which Mr. H. Dew acted as Director, he was succeeded by Dr. C. H. Kellaway in August, 1923. After twenty years of service to the Institute, Dr. Kellaway resigned to take up the post of Scientific Director of the Wellcome Foundation, and Dr. F. M. Burnet was invited to succeed him in March, 1944.

In presenting the 25th Annual Report of the Director of the Walter and Eliza Hall Institute, the Board desires to express its deep appreciation to all who have contributed to the funds or have shown interest in other directions in the work of the Institute.

Inevitably, this work will expand in the near future, and it is hoped therefore that the financial support of those who realise the value of medical research to the community will be increased.

It is also desired to refer to the departure of Dr. C. H. Kellaway, who, having accepted an invitation to become Director-in-Chief of the Wellcome Research Laboratories in London, resigned on 29th February, 1944, from the position of Director of the Institute, to which for a period of 20 years he had rendered conspicuous service. The Board expresses regret at the loss of his services and its best wishes for his future success.

The Assistant Director, Dr. F. M. Burnet, a most distinguished worker in the field of medical science, was invited to accept the vacant position, and his acceptance was a matter of deep satisfaction to the Board.

It is with deep regret that reference is made to the death on 14th April, 1944, of Mr. Philip Aitken, who was one of the representatives of the Walter and Eliza Hall Trust on the Board of the Institute. This vacancy has been filled by the appointment of Mr. H. D. Giddy.

On behalf of the Board,

B. T. ZWAR,

Chairman.

The Director's Twenty-fifth Annual Report

TO THE BOARD

OF THE

Walter and Eliza Hall Institute of Research
in Pathology and Medicine

JULY, 1944.

Two landmarks in the Institute's history must be noted this year. A quarter of a century has now passed since the Institute commenced to function in 1919, under Dr. Patterson. A much more important event, however, has been the resignation of Dr. Kellaway, and his departure to England to take up the post of Director in Chief, Research Laboratories, Wellcome Foundation.

For twenty years Dr. Kellaway has guided and developed the Institute to its present status. When he took over in 1923 a useful foundation had been laid, but the subsequent expansion of the activities and the reputation of the Institute were due wholly to his scientific ability, his enthusiasm, and his skill and wisdom in human contacts.

In the interim between Dr. Kellaway's appointment with the Wellcome Foundation and his departure to England, an invitation to deliver the Dunham Lectures, at Harvard Medical School, gave me an opportunity to visit laboratories in the United States and Canada before taking over the directorship.

The subject of the Dunham Lectures was "Some Virus Disease of Man—Ecological and Evolutionary Considerations," and several other lectures on aspects of virus research were given at other centres in America. I met most of the leading workers in virus research, and particularly appreciated the opportunities given me to see many aspects of the work on infectious diseases being carried out by the U.S. Army authorities.

The work of the Institute has continued to be directed mainly toward problems concerned with the medical aspects of the war. Up to the time of his departure for England, Dr. Kellaway was engaged with Mr. Rawlinson in studies of the

response of isolated organs to heat, with a view to the elucidation of some aspects of the basic pathology of shock in human burns. Studies on respiratory diseases in army camps, with special reference to the epidemiology and prevention of influenza, have been continued by workers in the virus department. The more recent methods for the study of influenza virus by various types of chick embryo inoculation, and by red cell agglutination tests have been elaborated and refined. Considerable advances have been made toward an understanding of the changes which take place in influenza virus strains when they are isolated from the human patient. Large scale experimental immunisation was carried out during the year, but in the absence of any epidemic no evidence as to its effectiveness was obtained. Since the death of Miss Lush last year, only a limited amount of work on scrub typhus has been possible, but close contact has been maintained with the army authorities in regard to the problem, and it is hoped to provide further experimental assistance in the near future.

Dr. Nagler has been engaged on devising methods for the rapid bacteriological diagnosis of anaerobic infections, and in assessing the susceptibility of the organisms causing gas gangrene to penicillin.

In the biochemical department work on the estimation of carbon monoxide has been continued, and other investigations on toxic gases liberated into vehicles during gun fire were carried out. Dr. Gottschalk has made further progress in his investigations on the fundamentals of alcoholic fermentation by yeast.

The Institute has continued the blood-grouping for the services in Victoria, carrying out about 25,000 tests, a considerably smaller number than in the previous year. Blood tests have also been made as before on donors for the Red Cross Transfusion Service and the Blood Bank. The technical services of the Red Cross Transfusion Service have continued to be housed in the old Institute building.

Our association with an adjacent U.S. army hospital has been very helpful to us in many ways, and we were sorry to see them depart. During the year we were able to provide facilities for some researches on herpes virus infections on the cornea in malarial subjects undertaken by members of the hospital staff.

The financial position of the Institute has again been under consideration. The new buildings at Parkville have provided much more satisfactory working conditions for the staff, but their maintenance represents a considerably larger proportion of our budget than previously. If the potentialities of our buildings and equipment, and of our association with the hospital, are to be exploited economically we must look forward, especi-

ally in the post-war years, to an increased activity requiring a correspondingly increased financial support.

There are only two sources of additional money available to us, the public and Governmental agencies. In July and August an organised, semi-public appeal for funds was made. The organisation of the appeal was in the hands of Mr. A. Morcom, deputy assistant manager and public relations officer of the Royal Melbourne Hospital. His work was facilitated by the generous co-operation of Dr. Julian Smith in providing photographic illustrations for a brochure describing the work of the Institute.

The appeal resulted in a generous response from many donors, and a total of £4075 was obtained. Included in this amount is £610, which was subscribed as a memorial to Miss Dora Lush. A list of donors is printed as an appendix to this report.

We are particularly appreciative of the action of the Truby and Florence Williams Charitable Trust in providing a special grant of £1000 in support of the Institute's work.

We hope that in the post-war period the Institute may be able to play a major part in training men who have served as medical officers in the forces, and who wish to enter the field of medical research either as a permanent career, or as a preliminary to other types of work. Suggestions that the National Health and Medical Research Council should provide additional support to the Institute to allow it to equip itself for and to carry out such functions have been submitted to the Council.

With the transfer of the Royal Melbourne Hospital to the new buildings in the near future, it will again be possible to have a closer association between the Institute staff and those concerned with the routine pathological biochemical services. I am particularly hopeful that as soon as conditions allow, combined activity of the hospital and the Institute will ensure a steady output of clinical research.

Until his departure, Dr. Kellaway continued to serve as Honorary Scientific Liaison Officer to the Medical Directorate at L.H.Q. As such he has been intimately concerned with nearly all aspects of physiological research on army problems in Australia. He was chairman of the Armoured Fighting Vehicles Committee of the N.H.M.R.C., and a member of the Flying Personnel Research Committee of the R.A.A.F., and of the Physiological sub-committee of the Chemical Defence Board. He also acted for the D.G.M.S. as medical adviser to Army Inventions Directorate.

Mr. Holden has been a member of the special committee on Industrial Hygiene in Munitions Establishments.

I have lectured on epidemiological subjects to R.A.A.F. and Army medical officers, and have been available to the Director of Hygiene and Pathology for consultation on bacteriological matters. While in America I lectured to U.S. service medical officers in Washington and San Francisco, and spent three days, at the request of the U.S. Army Commission on Respiratory Infections, in the field laboratory at Fort Bragg.

VIRUS DEPARTMENT.

During the year under review most of the work of the Virus Department has again centred around the problems of influenza in its relationship to Army personnel. Throughout we have had the full co-operation of the Army authorities in this work. The laboratory work has been the full-time occupation of Dr. Beveridge, Miss Bull and myself (apart from the period of my absence abroad), while the field work has been the responsibility of Dr. Williams. There was no epidemic of influenza during the winter of 1943, but cases of both influenza A and B were detected occurring in sporadic fashion. In 1943, large scale immunisation of troops by intranasal administration was conducted on a semi-experimental basis, but in the absence of an epidemic no conclusions as to the efficacy of the method could be reached. A similar project for 1944 has been initiated. Apart from the influenza and related investigations, Dr. Nagler has worked on the early diagnosis of gas gangrene due to *Clostridium oedematiens*, and on the effect of penicillin on organisms of this group.

Dr. Williams has begun studies on atypical pneumonia and psittacosis with special reference to the action of penicillin on psittacosis virus.

The Epidemiology of Upper Respiratory Infections.

Throughout most of 1943 the Australian army authorities informed us of the number of troops reporting sick each week due to upper respiratory tract infections in Victorian camps. Dr. Williams visited camp hospitals twice a week and obtained specimens of blood and throat washings from patients with influenza-like illnesses. In this way a fairly complete picture of the incidence of influenza A and B, and other similar respiratory infections was obtained.

The incidence of upper respiratory tract infections sufficiently severe for the soldier to report sick was at no time greater than 0.7 per cent. per week. Sporadic cases of influenza A were detected in May (3 cases), June (4 cases), and September (1

case), and influenza B cases were detected almost each week from mid June to the end of September. These infections occurred in several widely separated camps, and nearly all of them were quite unassociated with any unusual prevalence of respiratory diseases. During July, when there was a slight general prevalence of respiratory infections (0.7 per cent.), there were only three cases of influenza B and no influenza A among 33 cases studied (9 per cent.), whereas during August and September, when the slight general prevalence had subsided, there were 12 cases of influenza B and one of A among 32 cases studied (40 per cent.). These findings, together with some of a similar nature which recently came to hand from overseas, lead to a modification of previous concepts of the epidemiology of influenza B. It is now regarded as a disease which ordinarily occurs sporadically, but may at times give rise to epidemics.

Clinically, most of the cases of influenza B could not be differentiated from other cases of respiratory infection of unknown aetiology. Many were preceded by a "cold" and had an insidious onset. Such cases have usually been regarded by virus workers as not due to influenza virus.

The incidence of upper respiratory infections showed an inverse correlation with climatic temperature in the autumn and early winter, but from August onward the relationship was more remote. Apparently either acclimatisation to the lower temperature or else immunisation to the infections occurred by the end of August.

Isolation and Study of Influenza A and B Strains.

A new method of isolating influenza A virus by inoculating throat washings, after filtration into the yolk sac of chick embryos, has been developed. Three strains were isolated by this method. It has the advantage of simplicity; also, by this method of inoculation it is easier to propagate the virus in the original "O" phase. However, it is less sensitive in detecting virus than the amniotic method, which, as in 1942, proved very efficient. Four strains were isolated by this method. All strains isolated were in the "O" phase, and were serologically of the same general type as the standard strain "Melbourne."

Influenza virus B proved much more difficult to isolate than influenza virus A. Throat washings from 11 cases of this disease were inoculated into embryos, but only one strain was isolated. This strain, BON, is the first strain of influenza B to be isolated in Australia, and the first obtained directly by chick embryo methods. On passage in chick embryos BON showed much the same changes in character as influenza A strains show in the O to D variation, but the change occurred gradually, and

not sharply as with A strains. Yolk sac passage can be carried out for at least nine generations without demonstrable change in the unadapted character of the strain. During its early passages BON multiplied much more slowly in the embryo than any other strain of influenza virus so far studied by us. Serologically it is only distantly related to the standard influenza B strain LEE. Embryos 8 or 10 days old can be infected with only 100th the amount of virus necessary to infect 12 day embryos with this strain. BON was attenuated in the usual way by 40 passages in chick embryos and used in immunisation of troops in the autumn of 1944.

Neutralization of Influenza Virus in the Allantoic Cavity of the Chick Embryo.

A simple method for testing the activity of antisera against influenza virus is to inoculate serum-virus mixtures into the allantoic cavity of the chick embryo. The method was used for practical purposes in the Institute during 1942-43, and during the present year I have carried out a limited study of the theoretical aspects of the technique. It is unique amongst virus antibody titration methods in that the mixtures are not deposited on a sensitive surface or injected into a semi-solid tissue, but are liberated into a relatively large volume of fluid. Any given virus particle will have repeated opportunities for making contact with susceptible cells as it is moved about by the movements of the embryo. This is probably responsible for the finding that the power of serum to neutralize virus falls off much more sharply with dilution in the allantoic cavity than by any other method of carrying out serum neutralization reactions. The results of this theoretical study allowed a satisfactory explanation of the reactions obtained last year with human serum tests and also gave some interesting additional data on the process of adaptation associated with repeated passage of influenza virus strains in the allantoic cavity.

Immunisation Against Influenza.

No information as to the efficacy of the immunisation carried out on the troops during 1943 was obtained because there was no epidemic of influenza. As in the previous year, there were no serious reactions as a result of the intranasal administration of the attenuated virus. A similar project has been undertaken for 1944, except that this year the immunisation was done earlier, during February and March. This change was made because it was thought that there would then be less likelihood of the infection with the attenuated virus being followed by secondary infection with bacteria. Half of those immunised received influenza A and half influenza B, and the strain each soldier

received was noted in his records book. This year the A strain used was BEL, which was isolated in Victoria in 1942, and the B strain was the recently isolated BON.

A small scale experiment was carried out in medical student volunteers. Half were given subcutaneous inoculation of formalinised virus and half intranasal spray of attenuated virus. Six months later all were given attenuated virus intranasally. Nearly all in each group failed to show an antibody rise to this challenge dose. From this result it would appear that both methods conferred a satisfactory degree of immunity. Actually another interpretation of these results is possible consequent on new findings on the immunology of influenza which came to light during the year and which are reported below.

Antibody Response to Subcutaneous Inoculation.

All workers in this field agree that the degree of antibody rise to subcutaneous inoculation of influenza virus varies greatly from one individual to another, but there is no explanation as to why this is so. While investigating irregularities in antibody rise in different groups, Dr. Beveridge found that after a person has had one subcutaneous inoculation, a second one given a few weeks or even months later seldom causes any antibody to be produced, which is in contrast to the results in most other immunising procedures. This applies to persons who have some basic immunity from a previous attack of influenza, and probably would not hold in children who have never had influenza. Some individuals show no antibody rise as a result of the first inoculation; usually these also fail to respond to a second or even a third inoculation. In some cases the explanation seems to be that the first inoculation produces the maximum response—an immunological ceiling beyond which it is not possible to go. But in other instances this does not seem a satisfactory explanation, because there is very little antibody present either before or after the inoculations!

The finding that a second antigenic stimulus within a few months of a previous one seldom causes an antibody response, affects the interpretation of the results of some experiments on immunisation done overseas and here. It now seems likely that absence of a subsequent antibody rise in vaccinated persons cannot be taken as evidence that they did not contract the disease. The vaccination may “protect” against their ability to show an antibody rise rather than against the disease.

Attempts at Isolating New Viruses.

The programme of work on respiratory diseases carried out in conjunction with the army included attempts to isolate viruses

from those respiratory infections not due to the two known influenza viruses. Material from many of these cases have been inoculated into eggs by all the accepted methods without success. Efforts have been made to determine the conditions under which the embryos are likely to be most susceptible to virus infections. It has been found that 8 or 10 day embryos are more sensitive in detecting minimal amounts of influenza virus B than are 12 day ones, whereas with influenza virus A, 12 day ones are slightly more sensitive than 8 day ones. It has been known for some years that the temperature of incubation after inoculation has a marked effect on the susceptibility of the embryo to some viruses, but hitherto the temperature before inoculation has not been thought to have any effect. Dr. Beveridge has now found that eggs which have been subjected to preliminary incubation at 102°F. are less susceptible to influenza virus inoculated into the allantoic cavity than are eggs incubated at 98° or 100°F.; also, the former yield only about half the volume of allantoic fluid virus than the latter do. This finding is of practical importance in production of vaccine, and may have a significance concerning the susceptibility of the chick embryo to other viruses. An unsuccessful attempt was made to produce eggs deficient in riboflavine, in the hope that the embryos may be more susceptible to viruses and the Rickettsia of scrub typhus. A group of fowls were fed on a diet which, according to analyses of overseas foodstuffs, should have been grossly deficient, but analysis of the eggs showed that there was no deficiency. The Institute is indebted to the Institute of Anatomy, Canberra, for these analyses.

One of the problems in isolating new viruses is how to detect the presence of the virus in the embryo. Some viruses are known to multiply in the embryo without producing any detectable signs of infection. As a possible approach to this problem, and to help obtain a general understanding of the growth of viruses in the embryo, studies are being made of the histology of embryos infected with influenza virus. After allantoic infection there is surprisingly little cellular damage to the living epithelium, and it is difficult to understand how so much virus can be liberated into the cavity without causing more easily visible changes in the cells from which it presumably arises.

Influenza on the Conjunctiva.

A few experiments on volunteers have shown that influenza virus dropped on to the human conjunctiva produces in most individuals a mild conjunctivitis. On one occasion the virus could be reisolated from the infected eye on the following day. These findings are of interest because it has been generally believed that only the lining membrane of the respiratory tract is sus-

ceptible to infection with influenza virus. Also the method may prove useful for experimental purposes.

Epidemiology of the Common Cold.

Dr. Beveridge has collected data on the incidence of colds in members of the Institute staff and some of their families during the past year. The mean number of colds per person for the year was 4.5, but the number per person which was most common (the mode) was 2. There was great variability in the susceptibility of different individuals, the extremes being one person who had no colds and one who had eleven. There was clear cut evidence of contagion within family groups. No period of immunity was constantly found after a cold, but a second cold was less likely to occur within four to six weeks of a previous one. A few individuals showed fairly regular intervals between colds, suggestive of a period of immunity. The period between onset of colds in members of the same family between whom contagion probably occurred, varied between from two to six days. This suggests that the usual period of incubation may be about two days. Since the period of infectivity plus the incubation period may be as long as six days, apparently a person with a cold may remain infective for other persons for four days after onset. The data are too few for these deductions to be more than tentative. A larger number of persons are now under observation.

Interference Phenomena in Influenza Virus Infections.

In recent years a number of instances have been described in which infection by a mild strain of virus will prevent infection by a more virulent strain. This preventive action is apparent almost immediately after infection, and is not due to the development of specific antibody. After some unsuccessful attempts to demonstrate "blockade" phenomena of this sort in mice, Miss Bull and I found that when a non-fatal allantoic infection with a typical stock influenza virus was produced in a series of chick embryos, these were protected for some days at least from infection by the highly lethal viruses of Newcastle disease and of the fully adapted Melbourne strain of influenza A.

While this work was in progress the work of Henle and Henle on blockade in the allantoic cavity by partly inactivated influenza virus reached us. We have been able to confirm their work, and as opportunity offers attempts to correlate histological findings in the membranes with these phenomena are being made.

Gas Gangrene.

Dr. Nagler has continued his work on the anaerobes responsible for gas gangrene, and has developed a method for the rapid bacteriological diagnosis of infection with *Clostridium oedematiens*. Material from the wound is inoculated onto a special medium containing egg yolk. After incubation anaerobically overnight *Cl. oedematiens* colonies develop with a pearly lustre and surrounding reduction zone. None of the other anaerobic and aerobic bacteria tested show both these characteristics, and the method seems likely to be of practical value in field laboratories. A limited investigation of the nature of the chemical reactions leading to the appearance of the iridescent surface material is being undertaken in collaboration with Miss Law, of the University Department of Biochemistry.

Dr. Nagler is now studying the susceptibility of anaerobic organisms, especially *Cl. welchii*, to penicillin, and has worked out methods for the quantitative estimation of inhibition by penicillin.

Scrub Typhus.

Dr. Williams carried on the work with scrub typhus after Miss Lush's death. Experiments have been done on chemotherapy, but the results cannot be disclosed at present. A strain was handed over to the U.S.A. Naval authorities for shipment by air to America. There are no further developments to report with this work, the organism having proved a very difficult one to cultivate satisfactorily.

F. M. BURNET:

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- F. P. O. NAGLER:
"Bacteriological Diagnosis of Gas Gangrene Due to Clostridium oedematiens," "Nature," 1944, 153, 496.
"Red Cell Agglutination by Vaccinia Virus. Application to a Comparative Study of Vaccination with Egg Vaccine and Standard Calf Lymph," "Australian Journal of Experimental Biology and Medical Science," 1944, 22, 29.
"A Specific Cutaneous Reaction in Persons Infected with the Virus of Herpes Simplex," "Journal of Immunology," 1944, 48, 213.

PHYSIOLOGY DEPARTMENT.

Until his departure for England, Dr. Kellaway, in collaboration with Mr. Rawlinson, continued his studies on heat injury. The application of the method of perfusion of isolated tissues with saline to the study of the effect of heat in producing tissue injury though it facilitates the detection in the perfusate of pharmacologically active substances and enzymes, inevitably complicates the problem by providing for the cells an environment deprived of the buffering and osmotic effect of the serum proteins, and with a low oxygen tension. The question at once arises as to whether the liberation of active substances into the perfusate can be attributed to the damaging effects of heat or to anoxia increased in degree by the increase of tissue metabolism brought about by rise of temperature.

They, therefore, studied the effects of heat on the isolated lungs of guinea pigs ventilated with oxygen, air and nitrogen. These organs even when ventilated with nitrogen may be perfused at 37°-38° C. for six or more hours without showing evidence of gross injury as indicated by the liberation of histamine into the perfusate. In two groups of experiments at 45°C. in which the lungs were ventilated with air and nitrogen respectively, no significant difference was detected in the output of histamine during six hours' perfusion. These results showed that anoxia did not cause gross injury to tissue cells, and suggested that it was unlikely to aggravate heat injury to a significant extent.

It was then decided to ascertain the effects of cellular injury by moderate degrees of rise of temperature and in particular to study the liberation of enzymes. Before experimenting with complex structures such as limbs, it was thought desirable to study a relatively homogeneous tissue known to be rich in enzymes. The liver perfused through the portal circulation was most suitable for these studies. Its parenchymal cells are all of one type, they have a rich and varied content of enzymes, and they come directly into contact with the perfusion fluid, so that their constituents can be liberated directly into it.

After about seven hours' perfusion of the isolated liver of the cat with saline at 38°C., histamine, inorganic phosphate, alkaline phosphatase, catalase, esterase and proteolytic enzymes began to appear in the perfusate. This indicated cell damage, and it was important to decide whether this process was a determining or subsidiary factor at higher temperatures. The rapid increase in the rate of liberation of inorganic phosphate, alkaline phosphatase, esterase, proteolytic enzymes and to a lesser degree of histamine, when the temperature approached 40°-42°C., was considered greater than could be accounted for by the above process. The liberation of catalase and histamine just above 38°C. was slower than that of the other constituents studied.

The application of the well-known Arrhenius equation to the results of these experiments showed interesting relations between the temperature and the rate of liberation of various cell constituents. The liberation process for catalase satisfied this equation, and it was concluded that the determining step was characteristic of the enzyme. Alkaline phosphatase and esterase above 45°C. showed gross deviations from the Arrhenius equation, and it was concluded that irreversible heat inactivation was commencing. Catalase showed no such destruction up to 50°C.

After considering the various objections to the perfusion experiment, a preliminary study was made of the effect of moderate degrees of rise of temperature in the perfused limbs of the guinea pig and cat. In spite of this technique being unable to afford direct evidence concerning the systematic effects of burns and scalds, it was thought that it might prove to be useful in the search for toxic substances whether these were cell constituents or formed consequent upon heat injury, in the cells or tissue spaces by enzymatic action.

From the perfused hind limbs of the guinea pig, histamine was liberated between 45° and 50° C., and histaminase from the uterus in preparations from females. No active adenylyl compounds were detected in the perfusate between 37.5° and 53° C., but at 43° and 45° C. there was cardiodepressant activity more

prolonged than that of adenosine, which was not diminished by incubation with cat liver extract rich in enzyme capable of inactivating adenyl compounds. Subcutaneous oedema fluid had similar activity.

From the cat forelimb histamine, but no histaminase, was liberated between 43° and 50°C. In the early hours of perfusion a smooth muscle-relaxing substance, which inhibited the stimulant effect of histamine, was present in the perfusate. No active adenyl compounds could be detected between 37.5° and 50°C., but cardiodepressant activity, similar to that in perfusates from the guinea pig hind limb, was found between 42° and 50°C. This was present also in the subcutaneous oedema; it was heat stable and was not diminished by incubation with cat muscle or cat liver extracts. Preliminary experiments to discover its source all yielded negative results, and because it is not possible at present to extend this work no opinion can be offered either of the nature or the significance of this cardiodepressant activity.

C. H. KELLAWAY and W. A. RAWLINSON:

“Studies on Tissue Injury by Heat. I. The Influence of Anoxia,” “Australian Journal of Experimental Biology and Medical Science,” 1944, 22, 63.

W. A. RAWLINSON and C. H. KELLAWAY:

“Studies on Tissue Injury by Heat. II. The Liberation of Enzymes from the Perfused Liver,” “Australian Journal of Experimental Biology and Medical Science,” 1944, 22, 69.

C. H. KELLAWAY and W. A. RAWLINSON:

“Studies of Tissue Injury by Heat. III. Isolated Limb Preparations,” “Australian Journal of Experimental Biology and Medical Science,” 1944, 22, 83.

BIOCHEMICAL DEPARTMENT.

Mr. Holden's work has again been largely concerned with investigations required by the Services. The method he devised last year for the quantitative estimation of small percentages of carbon monoxide has been extensively employed for the analysis of air samples for the R.A.A.F. and for the Armoured Fighting Vehicles section of the Army. Since November, 1943, determinations for the R.A.A.F. have been carried out by L.A.C. Watt, R.A.A.F., working in the Institute under Mr. Holden's direction. Mr. Watt has also helped in other Institute work involving such CO determinations.

From the standardization of the oxyhaemoglobin solutions used for CO determinations, Mr. Holden has devised a simple colorimetric method of greater accuracy than those commonly

used for chemical purposes. In principle the method depends on the use of a blue-green light source, and the comparison of the oxyhaemoglobin solution against a permanent glass standard.

It is probable that such a method might be valuable in industrial survey work, and in the control of the health of workers in unhealthy occupations.

As usual Mr. Holden has been called upon for assistance in various difficulties experienced by workers isolated from their normal sources of supply. Amongst other activities he was able to make some special glass electrodes for a New Zealand Government laboratory, and to prepare sodium selenite needed for the bacteriological investigation of the typhoid epidemic at Cheltenham last year.

In continuation of his work on the blood pigments, Mr. Holden has carried out experiments on the relative denaturability of derivatives of the blood pigments of different species. The ease of denaturation appears to depend not only on the reagent used, and on the derivative chosen, but also on the species of animal that furnishes the blood.

In the course of comparative experiments on various types of partially disintegrated haemoglobins, Mr. Holden succeeded in preparing a hitherto undescribed green pigment from oxyhaemoglobin by the concurrent action of hydrogen cyanide sodium hyposulphite and oxygen.

This substance appears to represent the combined result of several processes.

1. The oxidation of the globin haemochromogen which is associated with
2. An irreversible alteration of the specific groups of globin and
3. An unmasking of additional haemochromogenic groups.
4. Alteration of the haematin molecules and their recombination with portions of the globin molecule other than those with which they normally combine.

The possibility that green pigments of this type may appear in certain pathological conditions of the blood appears worthy of investigation.

Mr. Holden recently succeeded in removing from the pigment what appears to be its prosthetic group and is accumulating a stock of this for a study of its properties.

H. F. HOLDEN :

“A Method for the Colorimetric Determination of Oxyhaemoglobin,” “Australian Journal of Experimental Biology and Medical Science,” 1943, 21, 169.

“The Blood Pigment and Cyanides; a Green Haemoglobin,” Ibid, 1943, 21, 159.

Dr. Gottschalk investigated the kinetics of alcoholic fermentation of d-fructo-furanose, which he had previously shown to be the only fermentable d-fructose modification. Pure cultures of *saccharomyces cerevisiae* and *saccharomyces ellipsoideus*, as well as commercial yeasts (brewery top and bottom yeast, distiller's yeast and baker's yeast) were used :

1. In experiments at 25°C. and with concentrations of d-fructo-furanose and of d-glucose between 0.1 and 0.5 p.c., under which conditions alcoholic fermentation is dependent on, but not proportional to the substrate concentration, the initial rates of d-fructo-furanose and of d-glucose fermentation in nitrogen were determined. (At 25°C. at 1 p.c. fructose solution at equilibrium contains about 18 p.c. of the sugar in the furanose form.) It was found that the rate of fructo-furanose fermentation if referred to that of glucose as 100 varies between 100 and 140 with different strains of yeast, but is constant for each strain. By culturing a strain of *S. cerevisiae* for many generations on a medium containing d-fructose and d-glucose respectively, as the only carbohydrate no change was observed in the relative rates of fermentation of the sugars concerned.

2. In a second series of fermentation experiments the rate of consumption of sucrose, which is split by yeast saccharase into alpha-d-glucose and beta-d-fructo-furanose, was measured at 0°C. and $\text{pH} = 4.5$. Under these conditions the mutarotation of fructo-furanose, i.e., the reversible interconversion of fructo-furanose to fructo-pyranose, proceeds at a low and known rate. Concentrations of yeast and of sucrose were so chosen that 50 p.c. of the disaccharide added was inverted within the first half-minute of the experiment, and that the decrease in hexose concentration due to fermentation followed the kinetics of a first order reaction. In a parallel experiment the rate of alpha-d-glucose consumption was determined under the same conditions. The determination of the sugar consumption in both the sucrose and the glucose experiments rendered possible, by application of a second order differential equation, the evaluation of the first order rate constants of the consumption of d-fructo-furanose and of d-glucose. The ratio of the velocity constants of d-fructo-furanose and of d-glucose consumption was found to be in reasonable agreement with the ratio of the fermentation rates obtained in the first series of experiments with the same yeast.

The rate of sugar consumption as determined in the second set of experiments represents the velocity of the enzyme reaction, which initiates the alcoholic fermentation of d-fructo-furanose and of d-glucose. The first step consists in the phosphorylation by hexokinase of the fermentable hexose at carbon atom six. The fact that the ratio of the specific rate varies within a wide range with different strains of yeast suggests that hexokinase is not a single enzyme, but an enzyme complex containing specific kinases for the phosphorylation at carbon atom six of d-glucose and of d-fructo-furanose. The concentrations of these individual kinases, "glucokinase" and "fructokinase," in living cells determine their capacities to utilize d-glucose and d-fructose respectively. Experiments to separate "glucokinase" from "fructokinase" are in progress.

Many thanks are due to Dr. A. W. Turner, Animal Health Laboratory, C.S.I.R., Melbourne, for his ready and valuable help in preparing the pure yeast cultures used in the experiments.

A. GOTTSCHALK:

"d-Fructo-Pyranose, a Sugar Unfermentable by Yeast,"
"The Australian Journal of Experimental Biology and Medical Science," 1943, 21, 133.

"The Proportion of Fructo-Furanose Present in d-Fructose Solution at Equilibrium (0°C.)." "The Australian Journal of Experimental Biology and Medical Science," 1943, 21, 139.

BLOOD BANK.

During the past twelve months 4035 voluntary donors of the Red Cross Blood Transfusion Service have been bled to supply blood and serum for the bank. The average weekly supply for emergency transfusions has been 46 pints of blood and 14 litres of serum. The production of wet serum for the year was reduced to 754 litres, an amount adequate for current demands, and this enabled 344 litres of the serum stock to be refiltered. During the disastrous bushfires which occurred in Victoria in the summer months this centre was responsible for the distribution of 473 litres of serum, together with 293 sterilized giving sets to be used for the administration of the serum. Some 218 litres of this serum was sent in response to emergency calls, while the remainder was distributed as part of a scheme to have serum and giving sets available at all base and district nursing hospitals. Serum was also supplied on request to bush nursing hospitals. We have continued to enjoy and appreciate the assistance and co-operation of the medical superintendent and staff of the

Royal Melbourne Hospital, and of the medical women who have voluntarily given their time to bleed donors, the Red Cross aids, and the donors. We offer our grateful thanks to Dr. Ella Macknight and Dr. Dorothy Synan, honorary medical officers to the blood bank; to Dr. Alice Correll, Dr. Isabel Ireland, Dr. Marion Wanliss, Dr. Doris Officer, Dr. Gwendolyn Nash, Dr. Joy Bell, Dr. R. Jakobowicz and Dr. M. Karoly, for continuing to give service in bleeding donors, and to the Red Cross aids who have been responsible for the care, cleaning, assembly and sterilization of all equipment used in the collection and giving of blood and serum.

A survey has been completed of the incidence of reactions in blood administered from the blood bank since its inception. In the period January, 1939, to January, 1943, blood was collected from 2546 donors, and the average volume of blood, not including anticoagulant, collected per donor was 500 c.c. It was found that blood collected from 19.8 per cent. of the donors was wasted, and 12.5 per cent. of this waste was due to the blood not being used before the 21 days' storage period had expired. Of the 1897 bloods collected and administered, reports showing the results of giving 1311 bottles of blood were returned by the medical officers. An analysis of these reports show that of the 1311 bottles administered to 1032 cases, 47 (3.6 per cent.) gave rise to reactions. This includes 30 febrile reactions, 7 of which were severe and accompanied by rigors, 7 cases of jaundice, 1 case of urticaria, and 2 reactions classified as haemolytic. This reaction rate compares more than favourably with that observed by other workers in England and America. The cases of jaundice referred to have all been observed within a day or two of the transfusion. No instance of delayed jaundice of the type seen after yellow fever immunisation has been observed.

As part of this survey, 98 bloods have been cultured after their maximum period of storage. The majority of these bottles of blood have been allowed to stand at room temperature for periods varying from 1 to 71 days prior to incubation for two days. Culture of these bottles after incubation showed that 11 were contaminated and that 10 of the contaminated bloods were in a small series of 22 bottles in which the caps fitted badly and the blood had travelled up the air tube during storage. It has always been our practice to discard bottles of blood in which this occurs, as they show a great tendency to leak when subjected to variations in temperature. No contamination was found in a series of 48 bottles which were incubated straight after collection, or after standing at room temperature only for 2-11 days. Thus the incidence of contamination of blood collected under routine conditions at the blood bank is 0.8 per cent.

The sensitivity of the red cells in the small cross typing tubes attached to each blood bank bottle have been compared with that of the cells inside the bottles. No difference was observed.

One hundred and thirty-five batches of approximately 3 litres of serum each have been clotted at various times to see if this and the presence or absence of merthiolate have any effect on the amount of precipitate which develops during storage and the appearance of the serum. These sera will be compared after various periods of storage.

Concentration and Drying of Serum.

The main problems in the adaptation of the "Hardy" method for drying of serum to a semi-commercial scale have been the recovery of the ether from the alcohol-ether mixture, the concentration of serum and the design of apparatus which would enable 15-30 litres of serum to be precipitated and filtered.

The ether recovered commercially contained 16 per cent. alcohol, and the texture of the dried serum obtained using the recovered ether was not as fine as that previously obtained. If, however, the recovered ether was washed with a 50 per cent. calcium chloride solution, distilled and dried, and then used for the preparation, a dried serum was obtained identical with that prepared with pure ether.

The draught chamber constructed enabled 25 litres of serum to be concentrated at 26°-28°C. in 24 hours.

The greatest difficulty in the design of the apparatus for the precipitation and filtration of concentrated serum has been in the design of the filter. It was found that the wet precipitate could only be packed to a depth of four inches if the transfer and washing of the precipitate was to take place in two hours. The diameter of the filter necessary for 5 litres of concentrated serum is 15 inches, and this factor, together with the size of the autoclaves available for sterilizing the apparatus, and the size of the refrigerator in which the precipitation is carried out, have limited the apparatus to coping with 15 litres of wet serum at each operation. A double cone filter has been devised which will enable the wet precipitate to be dried and then poured as a dry powder straight from the filter into the storage bottles. This apparatus is being manufactured in stainless steel, but its construction is as yet not complete.

In collaboration with Miss Splatt, an investigation has been commenced on the presence and incidence of jaundice, if any, after the transfusion of fresh and stored blood. Blood is collected from all patients receiving stored blood and direct and indirect transfusions at the Royal Melbourne Hospital before and at two and 24 hours after transfusion. The Van den Bergh, Fouchet

Test and Icteric Index are estimated, and the urine is examined for bile salts, bile pigments, urobilin and haemoglobin for 48 hours after transfusion.

M. BICK:

“The Blood Bank—Four Years’ Experience,” “Medical Journal of Australia” (in the press).

“Some Observations on Certain Bacteriological and Serological Examinations of Stored Blood,” “Medical Journal of Australia” (in the press).

RED CROSS BLOOD TRANSFUSION SERVICE.

With the reduction of production of serum for the Army the necessity for intensive drives for donors ceased, and in the year ending 31/3/1944, only 741 new donors enlisted, and were tested with regard to their blood groups, sub-groups, Rh-factor, serum-titre, haemoglobin value and Kahn reaction. But while less blood has been used for serum production the demand for stored and fresh blood has grown. It was, therefore, thought advisable to retest the Kahn reaction in the blood of donors who had not been tested for more than one year; 6363 such tests were carried out, and 534 additional Kahn tests were performed on blood samples sent to the Institute for Wassermann reaction.

As in the previous years the haemoglobin content of the blood of women donors who have given two or more transfusions has been examined, involving 6023 tests, and those women whose haemoglobin was found to be below the level accepted as normal (85 per cent. = 11.9 grams haemoglobin per cent.) have been suitably treated.

The titre of 378 batches of pooled serum was determined.

An expansion of the serological work of this department has been investigations connected with the Rh-factor. Our main concern was the establishment of a sufficiently large panel of Rh-negative donors. For this purpose blood samples of 4528 previously enlisted donors were tested. With the collaboration of obstetricians, and other medical practitioners, and the co-operation of the Women’s Hospital and Commonwealth Serum Laboratories, sera containing Rh antibodies have been accumulated during the last twelve months. An attempt has been made to investigate and classify these sera according to their composition of partial agglutinins, and a study has been made of the classification of red cells into Rh-subgroups. A considerable number of investigations on Rh and A-B-O incompatibility has been carried out on samples of blood sent by medical practitioners from Melbourne or other parts of Victoria, the samples mainly

being from patients with histories of repeated miscarriages, still-birth or sterility. In collaboration with the Queen Victoria Hospital, a series of investigations has also been commenced on the role of blood group factors in these conditions. At the time of their first attendance at the ante-natal clinic, 508 women have had their blood grouped, Rh-factor and serum titre determined; of these, 116 have been retested after delivery and the blood group and Rh-factor of the infant was determined. Two interesting cases occurred, one of a typical erythroblastosis foetalis and one of a mild anaemia of the new born unconnected with the Rh-factor and probably due to an A-B-O incompatibility. In both cases the mother was group O, and the child group A, and the anti-A titre had risen considerably during pregnancy, one reaching the highest figure ever encountered in this department. This work is still in progress.

R. T. SIMMONS, J. J. GRAYDON, RACHEL JAKOBOWICZ and LUCY M. BRYCE:

The Rh Factor. Its Incidence in a Series of Victorian Red Cross Donors." "Medical Journal of Australia," 1943, 2, 496.

RACHEL JAKOBOWICZ and LUCY M. BRYCE:

"The Rh Factor: Laboratory Aspects." Part of a symposium on the Rh-factor held by the Victorian Society of Pathology and Experimental Medicine on 13th December, 1943, at Melbourne. "Medical Journal of Australia," 1944, 1, 477.

ROUTINE TESTS FOR THE SERVICES.

Blood grouping tests for the Services have totalled 24,732. This is only about a third of the number done last year, and the Institute staff has been able to carry them through without outside voluntary assistance.

Miss Williams has carried out 1158 complement fixation tests during the year, two-thirds of them for the Services. They included 868 Wassermann tests and smaller numbers of hydatid, gonococcal and Bilharzia complement fixation tests. She has also made a large number of tests on surgical catgut for sterility and for loss of tensile strength after sterilization by heat.

ROUTINE HOSPITAL DEPARTMENTS.

Bacteriology and Clinical Pathology.

Diagnostic tests have been carried out along the same lines as previously.

Bacteriological investigations of cases admitted during the typhoid epidemic in 1943 have provided useful technical and

epidemiological data. Various types of selective media were tested, and a satisfactory routine procedure developed. This has been applied in making cultural tests on some of the residual carriers after their discharge from hospital.

A salmonella organism of unusual type was encountered in two patients, in one of whom the infection proved fatal. This organism is being submitted to further tests for identification.

A small group of patients with wound sepsis of streptococcal origin was investigated. Throat swabs from persons in contact were examined, and from one streptococci of the same type were isolated, thus indicating the source of infection.

Assistance has been given to the Services where facilities were not available for certain tests to be carried out.

Dr. Ruth Farrer, Major J. O. Lavarack and Captain Britten-Jones acted as assistants during the year. Miss A. Agar, B.Sc., has been appointed as full-time bacteriological assistant.

BIOCHEMICAL, METABOLIC AND ELECTROCARDIOGRAPHIC DEPARTMENTS.

The biochemical department has continued all its usual functions of performing such analyses on the hospital patients as are requested by the medical staff. The diabetic clinic has had glucose tolerance tests and Exton-Rose tests executed on a number of patients in whom the diagnosis was in doubt, and frequent estimations of blood sugar have been made on patients requiring stabilization. Acid and alkaline phosphatase estimations have been made on patients suffering from carcinoma of the prostate gland. The acid phosphatase is considered by Huggins and Hodges to be increased only in prostatic carcinoma, and a fall following operation to be a valuable prognostic sign.

Some six months ago treatment of cases of thyrotoxicosis by thio-urea or thio-uracil was commenced by physicians of the Hospital, and these patients have had weekly estimations of the basal metabolic rate and cholesterol content of the blood. The cholesterol content of the blood is low in cases of thyrotoxicosis, and this figure rises during treatment, and it is hoped that it will help to indicate the maintenance dose of thio-urea.

In collaboration with Miss Bick, an attempt has been made to investigate the effect of transfusions of stored blood, fresh blood, or blood given by the direct method, on the bilirubin content of the serum, and on the presence of haemoglobin, bile salts and pigments and urobilin in the urine.

This year has been a particularly heavy one, leaving no possibility of doing more than care for the immediate needs of the hospital patients.

Some eight hundred electrocardiograms have been made, and the tracings examined and diagnosed by Dr. Kate MacKay, the honorary electrocardiographist.

MORBID ANATOMY.

During the year 551 autopsies were performed. Dr. C. H. Mollison and Dr. R. J. Wright-Smith were responsible for the examination of 1823 biopsy sections from 1442 specimens. Sections from autopsy material numbered 759. Routine examination of the appendix removed at operation was carried out on 431 specimens.

Museum.

New specimens added to the museum included examples of Baker's cysts, regional ileitis, influenzal meningitis, polyarteritis nodosa, metastatic carcinoma in bone, polycythaemia vera and pseudo-mucinous cystadenoma of the ovary.

Teaching.

Dr. Wright-Smith has given the usual course of tutorial lectures in pathology to fourth year students. He has also given lecture demonstrations in morbid anatomy weekly to fifth and sixth year students, lectures in elementary bacteriology to the student nurses in the hospital and demonstrations of pathological material to the honorary and resident medical staffs.

Publications.

R. J. WRIGHT-SMITH:

"Metastatic Carcinoma in Lung and Suprarenal," "Royal Melbourne Hospital Clinical Reports," December, 1943.

"Hodgkin's Disease with Thrombocytopenic Purpura Complicating Chronic Pulmonary Tuberculosis," "Royal Melbourne Hospital Clinical Reports," December, 1943.

G. A. PENINGTON, R. KAYE SCOTT and R. J. WRIGHT-SMITH:

"A Case of Pituitary Basophilism" (In the press).

LIBRARY.

Our thanks for the gifts of journals and books are due to the following:—The Commonwealth Department of Health; The Council of Scientific and Industrial Research; Miss Danks; Mr. Dobell, F.R.S.; Dr. C. H. Kellaway, F.R.S.; The London Hospital; The Medical Research Council; The Middlesex Hospital Medical School; New York State Department of Health, Division of Laboratories and Research; Department of Pathology, University of Oxford; Rockefeller Institute, New York; Dr. R. J. Wright-Smith; The South African Institute for Medical Research; The University of Harvard, Department of Tropical Medicine; and The University of Pennsylvania, Department of Pathology.

F. M. BURNET,
Director.

LIST OF CONTRIBUTIONS

Sydney Myer Charity Trust (£100 for five years)	£500	0	0	McIlwraith, McEacharn Ltd.	10	10	0
Die Casters Ltd.	300	0	0	Michaelis Hallenstein & Co. Pty. Ltd.	10	10	0
The National Bank of A/sia Ltd.	260	10	0	Myttons Ltd.	10	10	0
Broken Hill Pty. Co. Ltd.	250	0	0	Mr. Vernon Smith . . .	10	10	0
The Danks Trust . . .	250	0	0	John W. Stamp Pty. Ltd.	10	0	0
Mr. Russell Grimwade	250	0	0	Allalemdjian & Co. Pty. Ltd.	5	5	0
The Herald & Weekly Times Ltd.	250	0	0	Mr. Roy Allison . . .	5	5	0
Messrs. M. H. and Norman Baillieu . .	200	0	0	Sir Frank Beaurepaire	5	5	0
Foy and Gibson Pty. Ltd. and Eagley Mills	100	0	0	Cyclone Fence & Gate Co. Pty. Ltd.	5	5	0
The H. V. McKay Charitable Trust . .	100	0	0	Eagle Star Insurance Co. Ltd.	5	5	0
Makower, McBeath & Co.	100	0	0	Mr. and Mrs. H. D. Giddy (£5/5/- annually)	5	5	0
The Moonee Valley Racing Club	100	0	0	Kelly & Lewis Ltd. . .	5	5	0
Mr. Lionel Weatherly	100	0	0	Loftus Moran Pty. Ltd.	5	5	0
Julius Kayser (Aust.) Pty. Ltd.	52	10	0	Godfrey Phillips (Aust.) Pty. Ltd. . .	5	5	0
Australian Paper Manufacturers, Ltd.	50	0	0	Mrs. D. Purbrick . . .	5	5	0
Bank of New South Wales	50	0	0	Warburton Franki (Melb.) Ltd.	5	5	0
Imperial Chemical Industries of Aust. and N.Z. Ltd.	50	0	0	Mr. H. P. Zwar, M.L.A. Zwar Bros. Pty. Ltd	5	5	0
Kraft Walker Cheese Co. Pty. Ltd.	50	0	0	Barrett Bros. & Burs-ton & Co.	5	0	0
Mr. and Mrs. L. J. Newton	50	0	0	Mr. Malcolm M. Brodie	5	0	0
Mr. Andrew Drummond	26	5	0	Manton & Sons Ltd. .	5	0	0
Alfred Lawrence & Co. Ltd.	26	5	0	Mr. J. L. Webb . . .	5	0	0
Australian Oxygen & Industrial Gases Pty. Ltd. (£25 annually for five years) . . .	25	0	0	Cadbury, Fry, Pascall Pty. Ltd.	3	3	0
E.S. and A. Bank Ltd.	25	0	0	Mr. J. T. Campbell . .	3	3	0
Mr. H. Mackenzie . . .	25	0	0	MacRobertson's	3	3	0
Melbourne Steamship Co. Ltd.	25	0	0	Mr. D. York Syme . .	3	3	0
Metropolitan Gas Co.	25	0	0	Tilbury & Lewis Pty. Ltd.	3	3	0
Brockhoff's Biscuits Pty. Ltd.	10	10	0	Arthur J. Veal Pty. Ltd.	3	3	0
Centenary Woollen Mills Pty. Ltd. . . .	10	10	0	B. J. Ball Pty. Ltd. . .	2	2	0
The Colonial Sugar Refinery Co. Ltd. (£10/10/- annually)	10	10	0	Blogg Bros. Pty. Ltd.	2	2	0
				Brooklands Accessories Ltd.	2	2	0
				Burns, Philp & Co. Ltd.	2	2	0
				Eagle & Globe Steel Co. Ltd.	2	2	0
				Gippsland & Northern Co-operative Co. Ltd.	2	2	0
				Mr. C. B. Hearn . . .	2	2	0
				New Zealand Insurance Co. Ltd.	2	2	0

G. Pizzey & Son Ltd. . .	2	2	0
Vacuum Oil Co. Pty. Ltd.	2	2	0
Wenzel Pty. Ltd. . . .	2	2	0
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Mr. Bradford Smith . .	2	0	0
Mr. T. A. Fancourt . .	1	1	0
Mr. V. P. Williams . .	1	1	0
Alliance Assurance Co. Ltd.	1	1	0
Yorkshire Insurance Co. Ltd.	1	1	0
Mr. C. D. Finch	1	1	0

Miss Jessie Bage	1	0	0
Mr. S. G. W. Shaw . . .	0	10	6
	£3,465	2	6

**Subscriptions to Dora
Lush Memorial Fund.**

Anonymous	£500	0	0
Mr. J. F. Lush	100	0	0
Miss P. Lavarack	10	0	0
	£4,075	2	6

The Walter and Eliza Hall Institute of Research in Pathology and Medicine

FINANCIAL STATEMENT FOR THE YEAR ENDED 30th JUNE, 1944.

RECEIPTS.				EXPENDITURE.			
To Balance 30th June, 1943	..	..	..	£6,690	14	4	
" Trustees W. & E. Hall Trust	..	..	..	£3,200	0	0	
" University of Melbourne	..	..	..	750	0	0	
" Scientific Liaison Bureau	..	..	..	300	0	0	
" Truby & Florence Williams Charitable Trust	..	..	..	1,000	0	0	
" Felton Bequests Committee	..	..	..	270	0	0	
" Estate Alfred Edmonds	..	..	..	100	0	0	
" Estate Anthony Mackie	..	..	..	150	0	0	
" Miss A. Danks—Donation	..	..	..	4	10	0	
" Miss M. Reid—Donation	..	..	..	1	1	0	
" Royal Melbourne Hospital	..	..	..	473	5	9	
" Proceeds for Monographs	..	..	..	197	12	0	
" Army, Air Force & Allied Works Council (Blood Typing)	..	..	..	1,088	6	9	
" Interest	..	..	..	628	0	11	
" Fees Received for Tests	..	..	..	474	18	8	
" Munitions Supply Laboratories—Refund	..	..	..	684	5	0	
				9,322	0	1	
				£16,012	14	5	
By Salaries and Wages	..	..	..	£6,547	13	9	
" Materials	..	..	..	1,054	4	9	
" Apparatus	..	..	..	0	17	6	
" Printing, Stationery, Postages, Electric Power and Light	..	..	..	299	8	0	
" Pay Roll Tax	..	..	..	184	14	8	
" Publications	..	..	..	100	4	5	
" Repairs to Apparatus	..	..	..	40	4	11	
" Maintenance and Cleaning	..	..	..	977	17	0	
" Library	..	..	..	129	7	11	
" Removal A.R.P. Provisions	..	..	..	546	13	5	
" Balance—				£9,881	6	4	
" Investments	..	..	..	2,947	13	2	
" Cash with Agent-General, London	..	..	..	24	14	7	
" E.S. & A. Bank	..	..	..	100	0	0	
" Bank of N.S.W.	..	..	..	3,059	0	4	
				6,131	8	1	
				£16,012	14	5	

SPECIAL APPEAL ACCOUNT

To Balance 30th June, 1943	..	..	..	£571	12	0	By Sundry Expenses	..	..	..	..	..	..	58	2	6
„ Donations	..	..	..	3,493	10	6	„ Transfer to Dora Lush Memorial Fund	..	..	..	..	..	..	600	0	0
							„ Balance—									
							Investments	..	..	..	£3,392	16	0			
							Bank of N.S.W.	..	..	..	14	4	0			
														3,407	0	0
														£4,065	2	6

DORA LUSH MEMORIAL FUND

To Donations—							By Investments	..	..	..	..	..	..	£610	0	0
Anonymous	..	..	..	£500	0	0										
J. F. Lush	..	..	..	100	0	0										
														£600	0	0
Miss P. Laverack	..	..	..	10	0	0								10	0	0
														£610	0	0

THE G. C. M. MATHISON ACCOUNT

To Balance 30th June, 1943	..	..	..	£196	9	10	By Salaries	..	..	..	..	..	..	£129	3	4
„ Interest on Investments	..	..	..	211	5	0	„ Balance	..	..	..	..	..	..	278	11	6
														£407	14	10

ELSIE MARION CARTY ACCOUNT

To Balance 30th June, 1943	..	..	..	£205	2	11	By Salary	..	..	..	..	..	..	£250	0	0
„ Interest on Investments	..	..	..	194	1	10	„ Balance	..	..	..	..	..	..	149	4	9
														£399	4	9

VIRUS ACCOUNT

To Balance 30th June, 1943	..	..	£1,036	17	2	By Salaries and Wages	..	..	..	£2,002	15	0
" Commonwealth Government	..	..	2,150	0	0	" Materials and Apparatus	..	..	..	1,528	12	3
" Ingot Metals Pty. Ltd.	..	..	375	0	0	" Balance	..	..	..	30	9	11
			£3,561	17	2					£3,561	17	2

ARMY MEDICAL RESEARCH FUND

To Balance	..	..	£101	5	1	By Balance	..	..	..	£101	5	1
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NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL GRANTS

To Commonwealth Government	..	..	£2,291	1	3	By Balance 30th June, 1943	..	..	..	£107	11	6
						" Salaries and Wages	..	..	..	1,518	4	4
						" Materials	..	..	..	159	10	5
						" Drawings	..	..	..	10	10	0
						" Balance	..	..	..	495	5	0
			£2,291	1	3					£2,291	1	3

ENDOWMENT FUNDS

To Biochemical Endowment Fund	..	..	£10,151	17	1	By Investments	..	..	..	£23,823	0	7
" Elsie Marion Carty Fund	..	..	4,531	3	6							
" Library Fund	..	..	2,030	0	0							
" G. C. M. Mathison Fund	..	..	6,500	0	0							
" Dora Lush Memorial Fund	..	..	610	0	0							
										£23,823	0	7

AUDITOR'S CERTIFICATE

I have to report that I have completed the Audit of the Books and Accounts of the Institute for the period ended 30th June, 1944. I have verified all receipts and have had vouchers produced for all disbursements. All information and explanations required have been given. The Statement is a correct statement of Receipts and Expenditure as revealed by the books of the Institute.

(Signed) W. M. JARVIE, F.C.A. (Aust.), Auditor.

